

Nelson Biology VCE Units 1 & 2

Answers to Chapter Questions

Chapter 3

Review questions

- 1 Specialised and unique chemical processes can occur within the specific membrane-bound organelles in eukaryotic cells. This allows many different chemical processes to occur at the same time. Prokaryotic cells do not have this opportunity and hence are limited in the types of chemical reactions occurring and the size they can ultimately grow to.

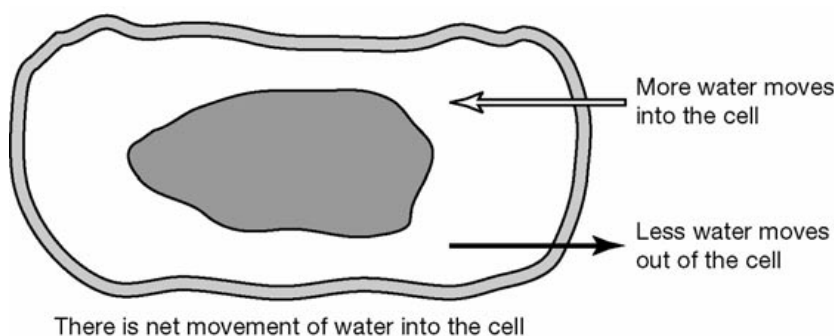
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Type of membrane protein	Function
Transport proteins	By spanning the plasma membrane from one side to the other they allow certain substances to pass through, but not others.
Receptor proteins	By binding hormones and other substances to the plasma membrane, these proteins cause changes to the cell's activities.
Recognition proteins	These proteins attach to carbohydrate molecules on the surface of the plasma membrane and act as markers, called antigens, which allow the immune system to distinguish between the body's self cells and non-self cells.
Adhesion proteins	In multicellular organisms, these proteins link cells together.

- 3 The plasma membrane behaves differently for different substances. It allows only certain substances to pass through it.
- 4 To start with, raspberry cordial particles are concentrated in the 30 mL added to the water. Because the particles are in constant motion, some move away from the original area into the surrounding water. This 'net movement' of cordial into the surrounding water from a region of high concentration to a region of low concentration is termed 'diffusion'. The difference in concentration is called the 'concentration gradient'. The net movement of cordial into the water will continue until the concentration of cordial throughout the drinking cup is equal – in other words, until equilibrium is reached.
- 5 When the concentration gradient is great, when heat is applied, when molecules are smaller and when movement occurs through a gaseous medium, the diffusion rate is increased.
- 6 Water is the solvent and salt is the solute.

- 7 Sucrose molecules are too big to fit through the pores in the differentially permeable membrane and so cannot diffuse across it.
- 8 The hypertonic salt solution has a higher concentration of salt compared to the red blood cells. This means the concentration of solvent (water) is lower in the salt solution compared to the red blood cells. Because water will move from where it is in higher concentration to a region where it is in lower concentration, it will move out of the cells into the surrounding salt solution. Hence the red blood cells become crenated.
- 9 a Plant cells do not burst when placed in a hypotonic solution; they become turgid. This is because the tough cell wall stretches, but does not break when there is a net movement of water entering the cell.

b



- 10 Turgor is important to plants because it keeps all the cells fully swollen, maintaining the shape and structure of the plant. This also enables plants to display their leaves fully for photosynthesis and enables stomata to open for gas exchange.
- 11 Although both carrier and channel proteins allow substances to move through the plasma membrane, they operate differently. Carrier proteins bind to specific substances on one side of the membrane, change shape and release the substance on the other side of the membrane. On the other hand, channel proteins form passageways through which certain substances can diffuse rapidly. Both types of proteins only allow specific substances to pass through the membrane.
- 12 In osmosis and simple diffusion, substances move from where they are in higher concentration to where they are in lower concentration and no input of energy is needed. In active transport, substances move from where they are in lower concentration to where they are in higher concentration. An input of energy is needed.
- 13 An example of active transport taking place is in cells that need to take in important substances, such as cells in the small intestine. Other examples are when cells release harmful substances, such as in kidney cells, and in cells that need to alter the concentration of certain ions such as in nerve cells.
- 14 In exocytosis, for instance in a cell that secretes enzymes, membrane-bound vesicles form around the enzymes and move through the cytoplasm to the plasma membrane, fusing with it and releasing the enzymes to the exterior of the cell. In endocytosis, the plasma membrane extends around a substance, engulfing it and forming an endocytic vesicle. This is then drawn into the cytoplasm.

- 15** **a** A 2 cm-round cell has a greater surface area to volume ratio compared to a 5 cm-round cell, so diffusion through its plasma membrane is more efficient. This gives it a greater chance of survival, as requirements are obtained and wastes are removed more quickly.
- b** By altering the shape of the 5 cm cell, efficiency of movement of substances across the cell surface can be altered. For instance if a cell is long and thin or has increased folding, its surface area is greatly increased, allowing for more efficient diffusion.
- 16** Mitosis is the stage in which the nucleus divides in two, whereas cytokinesis is the division of the cytoplasm that ends the cell division process.
- 17** Blood cells in adult humans need to be continuously replaced as they have a limited life span. Some cells are damaged by invading organisms and these need to be replaced. Cells on the skin and digestive system wear out quickly and need to be replaced constantly.
- 18** Stem cells are the source of new cells. They are unspecialised and immature. Without stem cells, differentiated cells in organs and tissues could not be replaced and death would result.

Apply understandings

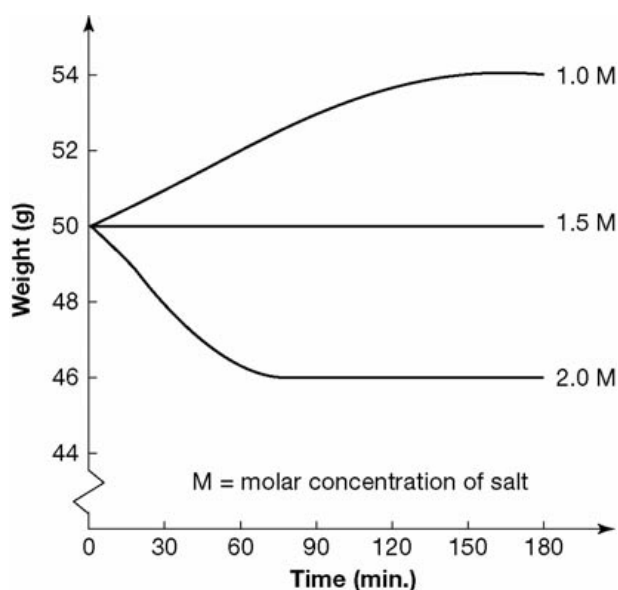
- 1** **a** Osmosis is similar to diffusion as no input of energy is required and substances move from a region of high concentration to a region of low concentration.
- b** A special features of osmosis is that it involves the movement of a solvent, usually water, across a partially permeable membrane.
- 2** **a** Z
- b** Y
- c** In the hypertonic solution, plant cell vacuoles lose water. The cytoplasm pulls away from the cell wall, leaving a gap between the cell wall and plasma membrane. There would be no change to the plant cell when it is placed in an isotonic solution.
- 3** Normal saline solution has the same solute concentration as the inside of the human cheek cell. This isotonic solution means there is no net gain or loss of water for the cell, which would result in the cheek cell looking the same as it is in the mouth. Tap water, however, creates a hypotonic solution, resulting in a net gain of water for the cell. This would distort the cell by making it swell and eventually result in the cell bursting.
- 4** Plant cells may become plasmolysed during drought or when living in an aquatic environment when evaporation exceeds rainfall, causing solutes in the water to become more concentrated.
- 5** The size and shape of the cells may be different. The larger the cell, the slower the rate of osmosis. Another factor could be a difference in temperature. The higher the temperature, the faster the rate of diffusion.
- 6** When salt surrounds the cells in your lips, there is a net movement of water out of the cells into the concentrated salt solution due to osmosis. This causes lip cells to dehydrate.

- 7 **a** Some of the sugar from the liquid 5% sugar solution surrounding the cell will enter the cell against a concentration gradient.
- b** If the hypothesis is correct, sugar must be entering the cell via active transport. This type of movement requires energy. The energy for active transport is supplied by cell respiration occurring in mitochondria. Large numbers of mitochondria indicate a high rate of cell respiration.
- 8 A particle that has been drawn into a cell by phagocytosis is still surrounded by a membrane and therefore is separated from the surrounding cytoplasm.

Investigate and inquire

- 1 **a** For diffusion to occur, there must be a higher concentration of wastes in the dialysis tube than in the surroundings. Wastes must therefore be constantly removed from the surroundings to maintain a concentration gradient.
- b** If the surrounding solution was not changed, the concentration gradient would become smaller and smaller until diffusion would no longer occur and the same amount of wastes would leave the dialysis tubing as would enter it.
- c** Students are to undertake their own research.

2 **a**



- b** The eggs placed in the 1.0 M concentration of salt gained water because the concentration of the solution inside the cell was greater than outside; i.e. the salt solution was more dilute than the solution inside the cell. In this hypotonic solution water moves osmotically into the cell.
 Eggs placed in the 1.5 M salt concentration did not gain weight because this solution was of equal osmotic pressure to that of the egg and therefore there would be no net movement of water into or out of the cell.
 Eggs placed in the 2.0 M salt concentration lost weight as the solution inside the cell was more dilute than the salt solution outside the cell. There is therefore a net movement of water out of the cell, resulting in loss of weight.
- c** Students are to do this investigation.

- 3 If the person drank the sea water, cells in the digestive system would be surrounded by a hypotonic solution and would lose water. Cells would become dehydrated and cease to function.
- 4
- a There will be a net movement of water into the *Amoeba* in a freshwater environment.
 - b *Amoeba* overcomes this problem by having structures called contractile vacuoles, which fill with the water that is entering the cell until they reach a certain size. When contractile vacuoles are full, they contract and break, releasing the water to the exterior environment, and then re-form to start filling with water again.
 - c Students are to research this. Interesting adaptations are observed in some animals. Marine birds and lizards have glands that release a concentrated sodium chloride solution. In birds, the glands open into their noses where the salty solution drips or is sneezed out. In turtles, glands are located behind the eyes and the salty fluid makes the animal appear to shed tears.
- 5 The bacterium *Vibrio cholerae* causes the disease cholera. Infected people have severe diarrhoea. The bacterium enters the body when a person drinks contaminated water, then sticks to the intestinal lining. It secretes a toxic substance to cells in the lining. Intestinal cells start secreting sodium and chloride ions into the intestinal fluid. This upsets the balance of fluids, causing a net movement of water out of the intestinal cells into the surrounding fluid which is then excreted with faeces, causing diarrhoea. Dehydration of body cells may eventually kill infected people.
- 6 Blood glucose levels are measured in millimoles of glucose per litre of blood (mmol/L). The normal level is around 5 mmol/L. A 5% solution of glucose is roughly equivalent to the normal level of glucose in the blood. If this concentration drastically increases (20%), body cells may be in danger of losing water by osmosis. Increased thirst and excessive urination are two of the symptoms of diabetes, a condition in which the amount of blood sugar rises to unacceptable levels.
- 7 Students are to do research. Fruit and vegetables are often sprayed with water to reduce water loss. This maintains the turgidity of cells for a longer period of time, causing the produce to look fresh and feel firm.
- 8 If salt levels rise, water tends to move from the root tissue in citrus trees to the surroundings by osmosis. There is a lack of water for photosynthesis, causing smaller yields of citrus fruit.